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# Initial Cost of Primary Angioplasty for Acute Myocardial Infarction

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***Objectives.*** **We sought to evaluate the initial economic cost of primary angioplasty for acute myocardial infarction under varying assumptions about whether a cardiac catheterization laboratory exists, whether services are provided during night and weekend hours and how cardiovascular surgical backup is arranged.**

***Background.*** **Primary angioplasty for acute myocardial infarction has resulted in clinical outcomes superior or equal to those obtained with thrombolysis in recent studies, but its future implementation depends greatly on its cost and cost-effectiveness. There is a gap in knowledge about the true economic costs of this procedure, and understanding costs under a variety of hypothetic scenarios is important in planning whether and how the procedure should be offered to broad groups of patients.**

***Methods.*** **A generalizable spreadsheet model was constructed to calculate the cost of primary angioplasty at a single hospital with assumptions based on data from a large nonprofit health maintenance organization (Kaiser Permanente). The following baseline assumptions were made: 1) A total of 200 patients with myocardial infarction presented to the hospital each year; 2) primary angioplasty was offered for 10 years; 3) the hospital had a cardiac catheterization laboratory; 4) costs of night call for technical personnel and cardiovascular surgical backup were already covered. Other scenarios were modeled to represent different assumptions about existing resources.**

***Results.*** **Under the baseline assumptions, primary angioplasty cost $1,597/procedure. If night call for technical personnel were a new expense, the average cost would be ≥$3,206. If a new cardiac catheterization laboratory needed to be built, costs would range from $3,866 to $14,339/procedure, depending on how cardiovascular surgical backup was provided. Results were sensitive to assumptions about the annual volume of myocardial infarctions, the number of years the procedure was offered and the costs of labor, construction and equipment.**

***Conclusions.*** **The initial cost of providing primary angioplasty for acute myocardial infarction varies greatly, depending on the setting in which it is provided. To provide information for clinical policy decisions, a cost-effectiveness model is needed that combines these initial costs with data on survival, quality of life and rates and costs of subsequent cardiac procedures.**

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During the past decade, both intravenous thrombolysis and primary angioplasty have been found to improve outcome among selected patients with acute myocardial infarction (1–5). Primary angioplasty may lead to a better outcome, but it has been assumed to have higher initial costs than thrombolysis, whose mean wholesale price ranged from $320 to $2,750/patient in 1993 (6,7). However, patients treated with primary angioplasty may have lower subsequent costs for future medical care for heart disease (8,9).

Estimates of the cost of primary angioplasty under varying assumptions are essential for those deciding how to most efficiently provide services to patients with myocardial infarction. Few estimates have been published. A 1988 report by the American Hospital Association listed a price range for angioplasty of $2,500 to $3,500, not including physician fees or hospital stay (10). However, the fees hospitals charge third-party payers often do not represent true economic costs because the charges for most services, especially procedures, are marked up (11). Physicians in policymaking positions need to understand true economic costs because health care in the United States is increasingly being covered under prospective payment systems.

For primary angioplasty, it is particularly important to understand potential costs under a variety of assumptions about existing resources because the procedure can only be provided by hospitals with a cardiac catheterization laboratory, and most hospitals in the United States do not have such a facility (12,13). Physicians and hospitals with such a laboratory need to determine the hours they will provide primary angioplasty services; those without laboratories must decide whether to build facilities, triage patients elsewhere or deny patients the procedure. To determine when primary angioplasty is cost-effective and to choose among various triaging systems, a

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**Table 1.** Costs of Primary Angioplasty Under Varying Assumptions About Resources*

| Scenario | Cardiac Catheterization Laboratory | Night Call for Technical Staff | Cardiovascular Surgical Backup | Elective Procedures Annually (angioplasty/ angiography) | Hours of Providing Primary Angioplasty | Present Value of Investment in Primary Angioplasty† (U.S. $) | Projected Annual Number of Primary Angioplasty Procedures | Projected Cost per Primary Angioplasty Procedure (U.S. $) |
|---|---|---|---|---|---|---|---|---|
| A | Exists | Exists | Exists | NA | All | 1,347,000 | 84 | 1,597 |
| B | Exists | NA | Exits | NA | Weekdays | 616,000 | 39 | 1,597 |
| C | Exists | New expense | Exists | NA | Nights and weekends | 2,088,000 | 45 | 4,564 (incremental cost‡) |
| D | Exists | New expense | Transport§ | NA | All | 2,704,000 | 84 | 3,206 |
| E | Exists‖ | New expense | Exists | NA | All | 2,230,000 | 84 | 2,644 |
| F | New expense | New expense | Transport§ | 0/0 | All | 6,230,000 | 84 | 7,387 |
| G | New expense | New expense | Transport§ | 100/700 | All | 3,261,000 | 84 | 3,866 |
| H | New expense | New expense | Start new program with two other hospitals | 0/0 | All | 8,184,000 | 84 | 9,704 |
| I | New expense | New expense | Start new program | 0/0 | All | 12,093,000 | 84 | 14,339 |

*In these estimates, the number of patients presenting to the hospital with myocardial infarction annually is held constant at 200, and the number of years that primary angioplasty is provided is held constant at 10 years. †Future costs are discounted to present value at 5% annually. ‡Incremental cost of providing primary angioplasty at night, given existing weekday primary angioplasty service. §Transport to neighboring hospital for emergency coronary artery bypass graft operations would be arranged. ‖In this scenario, technical staff costs are treated as fixed, and it is assumed that the laboratory is not operating at full capacity for elective procedures. NA = not applicable.

detailed analysis of its projected economic costs under varying scenarios is needed.

This study's goal was to establish a generalizable model to estimate the initial economic cost of providing primary angioplasty to patients with myocardial infarction presenting to a single hospital. The model allowed varying assumptions about 1) whether a cardiac catheterization laboratory existed, 2) whether services were provided during night and weekend hours, and 3) how cardiovascular surgical backup was arranged. Furthermore, we examined variations in the cost of primary angioplasty as we altered over plausible ranges both the number of acute myocardial infarctions treated annually at the hospital and the number of years the procedure was the preferred mode of therapy.

## Methods

**Model setting.** A generalizable spreadsheet model was constructed to calculate the costs of offering primary angioplasty for acute myocardial infarction. Probabilities of health outcomes were derived from published sources, and costs were based on estimates provided by administrators in the Kaiser Permanente Medical Care Program of Northern California; these inputs are discussed in detail later. Kaiser Permanente is a nonprofit, group model health maintenance organization whose physicians receive salaries based on time worked. The health maintenance organization provides the full spectrum of services, from preventive to tertiary care, to ~2.4 million patients over a region that includes 17 hospitals in the greater San Francisco Bay and Sacramento areas. Patients needing elective cardiac procedures are treated at one of the program's three cardiac catheterization laboratories or are referred to community hospitals outside the program.

Table 1 describes the nine scenarios (A through I) in the model. Each scenario includes different assumptions about how the hospital would provide resources needed for primary angioplasty. This study's baseline scenario (scenario A) was modeled on data from Kaiser Permanente's San Francisco hospital, whose cardiac catheterization laboratory operated weekdays between 8 AM and 5 PM. Cardiovascular surgical backup was already available. The cardiac catheterization laboratory operated at full capacity for elective angioplasty (550 procedures annually) and angiography (3,450 procedures annually). Cardiologist and technical staff labor were treated as variable costs because these providers carry out other functions when not performing invasive cardiology procedures. On-call fees to compensate two technical staff members for availability alone were already provided for 6,760 h annually, which included nights, weekends and holidays (8,760 h in a year minus 2,000 h during the 250 weekdays). If called in to work, technical staff received a higher rate of pay for those hours actually worked. Cardiologists and cardiovascular surgeons already are on call, and no extra fees for their availability were assumed.

Regional and local administration were calculated as a percent of labor costs. In the baseline scenario, it was assumed that the costs of maintenance of the building and equipment for the cardiovascular catheterization laboratory and cardiovascular operating room and the salaries of cardiovascular surgical personnel were already covered because of an existing ongoing interventional cardiology program.

Among hospitals that own cardiac catheterization laboratories, the availability of on-call technical personnel and cardiovascular surgical backup varies. Thus, we modeled several alternative scenarios in which the hours of offering primary angioplasty (scenarios B and C) and the costs of on-call status for technical staff and cardiovascular surgical backup varied. A small proportion of patients who present during the night or weekend hours have high risk characteristics: An estimated 3% have cardiogenic shock, and 6% have risk factors for bleeding and cannot be treated with thrombolysis (14,15). In the scenario in which primary angioplasty was routinely offered only during weekdays (B), it was assumed that the procedure would be provided during nights or weekends to those patients with high risk characteristics. Although these patients comprise only 9% of all patients with myocardial infarction, they have >25% of the 35% of myocardial infarctions that are eligible for primary angioplasty. If the hospital did not have a cardiovascular surgical program, it could transport patients needing emergency coronary artery bypass grafting (CABG) to neighboring hospitals (scenario D).

In some hospitals, technical staff labor may be a fixed rather than a variable cost. Scenario E assumed that technical staff costs were fixed and that the laboratory was not operating at full capacity for elective procedures. In this circumstance, the cost of technical staff labor for primary angioplasty procedures would, in effect, be zero as the technical staff would have extra time available.

From a regional or national policymaker's standpoint, a crucial factor in decisions about primary angioplasty is the fact that equipping a hospital with a cardiac catheterization laboratory requires a large initial investment. Thus, we modeled several alternative scenarios in which it was assumed that no cardiac catheterization laboratory currently existed at the hospital and one would be built expressly to provide primary angioplasty. The costs of building and equipping the cardiac catheterization laboratory and maintaining the equipment were added to the other costs of providing the service.

In northern California and many other urban areas, excess capacity for elective angioplasty and angiography already exists. A new cardiovascular catheterization laboratory would merely be taking procedures away from previously existing laboratories in the geographic area. In such situations, the economic cost of building and equipping a new laboratory should be attributed entirely to primary angioplasty. Therefore, in our scenarios the number of elective procedures performed at the new facility was initially set at 0—implying that no cost of the laboratory was allocated to these elective procedures.

In contrast, scenario G described an area where elective procedures had been going unperformed for want of a cardiac catheterization laboratory. In this scenario, it was realistic to apportion a part of the laboratory cost to these elective procedures. Most scenarios (F, G and H) assumed that cardiovascular surgical backup was provided through agreements with neighboring hospitals; one extreme scenario (1) assumed that a new cardiovascular surgical program would be started to provide on-site backup and that its costs would be charged in full against the primary angioplasty program.

**Table 2.** Probabilities and Costs in Model for Cost of Primary Angioplasty

| | Baseline Assumption* | Range for Sensitivity Analysis |
|---|---|---|
| Health outcomes | | |
| Number of myocardial infarctions annually | 200 | 50–400 |
| Proportion of myocardial infarctions eligible for primary angioplasty | 0.35† | 0–1.00 |
| Proportion of patients with pain and ST elevation who truly have myocardial infarction | 0.83‡ | |
| Proportion of myocardial infarctions occurring during weekday hours | 0.27§ | |
| Variable costs, per procedure (U.S. $) | | |
| Cardiologist and technical staff labor | 503 | 50%–150% |
| Supplies | 1,340 | |
| Fixed costs (U.S. $) | | |
| Night call pay for technical staff, annually | 175,760 | 50%–150% |
| Cardiovascular catheterization laboratory | | |
| Equipment maintenance, annually | 50,000 | 50%–150% |
| Equipment purchase¶ | 1,600,000 | 50%–150% |
| Construction¶ | 1,500,000 | 50%–150% |
| Cardiovascular surgical backup | | |
| Physician salaries, annually# | 677,019 | |
| Operating room equipment purchase# | 500,000 | |
| Operating room construction# | 135,000 | |

*Assumptions are from Kaiser Permanente Medical Care Program of Northern California except as otherwise noted. †Estimate is based on published studies (15,16). ‡Estimate is from the Chest Pain Study (19). §Estimate is from published studies (17,18) and Goldberg RJ, Brady P, Muller JE, et al. Time of onset of symptoms of acute myocardial infarction. Am J Cardiol 1990;66:140–4. ¶This cost was included only in scenarios in which there was no existing cardiac catheterization laboratory. #This cost was included only in scenarios in which there was no existing cardiac catheterization laboratory and a new cardiovascular surgical program was begun.

**Probabilities and costs.** Table 2 shows the probabilities and costs used in the model. The proportion of myocardial infarctions eligible for primary angioplasty and of myocardial infarctions occurring during weekday hours was estimated on the basis of published sources and analysis of Kaiser Permanente data (14–18). Patients were defined as eligible if they presented within 6 h of the onset of symptoms and had ≥1-mm ST segment elevation in two or more contiguous electrocardiographic leads. Patients in cardiogenic shock and those with bleeding risk factors that contraindicated thrombolysis were assumed to be eligible for primary angioplasty. A proportion of seemingly eligible patients with chest pain and ST segment elevation do not truly have myocardial infarction (19); however, it was assumed that primary angioplasty would be attempted for all and the volume of procedures was adjusted accordingly.

Costs were in 1993 U.S. dollars. Labor costs were calculated on the basis of the following assumptions: A cardiologist would devote 4 h, including time for preoperative and follow-up examinations and paperwork; a registered nurse and a cardiac catheterization laboratory technician would each devote 2 h; a supervising nurse would spend 0.6 h and a medical secretary and clerical person would each spend 1 h. Supply costs included the catheters and other disposable equipment, nonionic radiographic contrast medium and routine clinical laboratory testing. For night call availability alone, it was assumed that two technical staff members would each be paid $13/h for nights, weekends and holidays; these staff would be paid a higher rate for any hours actually worked.

For a cardiac catheterization laboratory, construction was assumed to cost $1.5 million and the laboratory was assumed to last 30 years; equipment was assumed to cost $1.6 million, to last 10 years and to have no resale value at any time after purchase. For cardiovascular surgical backup, 4% of patients receiving primary angioplasty were assumed to need emergency CABG. Transport to a neighboring hospital for this operation was assumed to cost $500, but the cost of the emergency CABG itself was not added to the total cost of primary angioplasty. To start a new cardiovascular surgical program, two cardiovascular surgeons and an anesthesiologist were assumed to be hired. For a cardiovascular surgical operating room, equipment was assumed to cost $500,000 and to last 10 years; construction was assumed to cost $135,000 and to last 30 years.

The baseline analysis was conducted by using the assumption that primary angioplasty would be provided for 10 years. Future costs were discounted at a rate of 5%/year. Results were expressed as the average cost per primary angioplasty. Future primary angioplasty procedures were not discounted; further analyses that translate primary angioplasty procedures into health benefits such as life-years saved would need to discount future health benefits (20).

**Sensitivity analyses.** Uncertainty surrounds the assumptions in any economic model. Sensitivity analyses were performed to evaluate how costs would change as key assumptions were varied over plausible ranges. These included the number of patients with myocardial infarction presenting to the hospital per year, the costs of labor, construction and equipment and the discount rate. Because the future is uncertain and new thrombolytic agents or other noninvasive interventions could later become the preferred mode of care for myocardial infarction, the number of years primary angioplasty was offered was varied over a plausible range.

## Results

The estimated total cost and cost per primary angioplasty procedure for each scenario are shown in Table 1. In the baseline scenario (A), assuming the hospital treated 200 myocardial infarctions/year, providing primary angioplasty during all hours was estimated to result in 84 procedures at a cost of $1,597/procedure. If the hospital had a laboratory but technical personnel were not on call at night, providing primary angioplasty only during weekdays (scenario B) would result in 39 procedures at a cost of $1,597/procedure. Providing full service on nights and weekends (scenario C) would result in 45 additional procedures on nights and weekends at an incremental cost of $4,564/procedure.

In scenarios without an existing cardiac catheterization laboratory, the projected cost of primary angioplasty was much higher. If a new laboratory were built and cardiovascular surgical backup were arranged through transport to a neighboring hospital (scenario F), the cost per primary angioplasty would be $7,387. If the new cardiac catheterization laboratory were assumed to also provide elective procedures over a 10-year life span (scenario G), the cost per primary angioplasty would be reduced to $3,866. If a new cardiovascular surgical program were initiated at the hospital but there was already a regional excess of existing capacity for cardiovascular surgery (scenario I), the average cost per primary angioplasty would be $14,339, more than nine times the cost of weekday angioplasties at a hospital with an existing cardiac catheterization laboratory.

**Sensitivity analyses.** *Volume of myocardial infarctions.* The cost of primary angioplasty was very sensitive to the volume of myocardial infarctions per year in most scenarios (Fig. 1). With an existing cardiac catheterization laboratory, if there were 400 myocardial infarctions annually, the incremental cost of offering primary angioplasty during nights and weekends decreased from $4,564 to $3,081/procedure, approximately double that of weekday procedures. In the worst-case scenario, if primary angioplasty were offered by a hospital that had only 50 myocardial infarctions annually and that needed to construct a cardiac catheterization laboratory and start a new cardiovascular surgical program, the cost per procedure would be >$50,000.

*Years that primary angioplasty would be provided.* In the scenarios in which a cardiac catheterization laboratory did not currently exist, the cost of primary angioplasty was dependent on the number of years the service would be provided (Fig. 2). Doubling the time frame to 20 years had little effect, but shortening it to <8 years markedly increased the cost of offering the procedure. In the worst-case scenario—if a laboratory were built, a new cardiovascular surgical program initiated and the service discontinued after 2 years—the cost would be almost $35,000/procedure.

*Proportion of myocardial infarctions eligible.* For scenarios in which night call for technical personnel was being added or a cardiac catheterization laboratory was being built, the cost of primary angioplasty was sensitive to the proportion of myocardial infarctions that would be eligible for the procedure. The effects of varying the proportion of myocardial infarctions eligible from 0 to 70% and of varying the annual number of myocardial infarctions from 0 to 400 were identical because both variables directly affected the number of primary angioplasty procedures (Fig. 1).

*Elective procedures.* In the scenario (G) in which a new cardiac catheterization laboratory was being built and elective angioplasty and angiography were assumed to be charged with part of these costs, the cost of primary angioplasty was

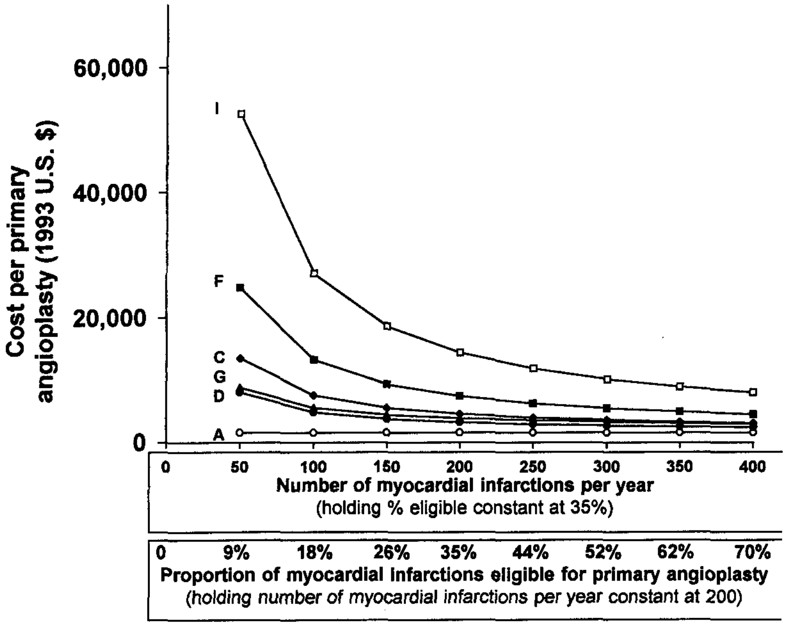


**Figure 1.** Sensitivity analysis showing the cost per primary angioplasty procedure as the number of patients who present to the hospital with myocardial infarction annually, or the proportion of myocardial infarctions eligible for primary angioplasty, is varied. In the **first row of x-axis labels**, the number of patients who present to the hospital with myocardial infarction annually is varied from 0 to 400 while the proportion of all myocardial infarctions eligible for primary angioplasty is held constant at 35%. In the **second row of x-axis labels,** the proportion of myocardial infarctions eligible for primary angioplasty is varied from 0 to 70% while the annual number of myocardial infarctions is held constant at 200. In both cases, it is assumed that the procedure is offered for 10 years. Scenarios A, C and D assume that a cardiac catheterization laboratory already exists; scenarios F, G and I assume that a new one is built and equipped. See Table 1 for detailed descriptions of scenarios.

relatively insensitive to increasing the numbers of elective procedures beyond 100 elective angioplasty procedures and 700 angiographic studies. For example, the cost of primary angioplasty decreased only to $3,356 (from the baseline estimate of $3,866) as the numbers of elective angioplasty and angiographic procedures were increased to 550 and 3,450, respectively. The cost of primary angioplasty was more sensitive to decreasing the numbers of elective procedures below baseline estimates. If the laboratory performed only 50 elective angioplasty and 350 angiographic procedures, the cost per primary angioplasty was $4,346.

*Labor costs.* Scenarios A and B, in which a cardiac catheterization laboratory already existed and night call for technical staff was not a new expense, were minimally sensitive to varying labor costs between 50% and 150% of baseline estimates. Scenarios in which night call for technical staff was a new expense were sensitive to varying assumptions about labor costs (Table 3).

*Equipment and construction costs.* For scenarios (F through I) in which a cardiac catheterization laboratory needed to be built, the cost of primary angioplasty was sensitive to the cost of construction and equipment (Table 3). However, the cost of primary angioplasty was minimally sensitive to the cost of building and equipping the laboratory in scenario G, in which the cost of the laboratory was counted against elective procedures as well as primary angioplasty.

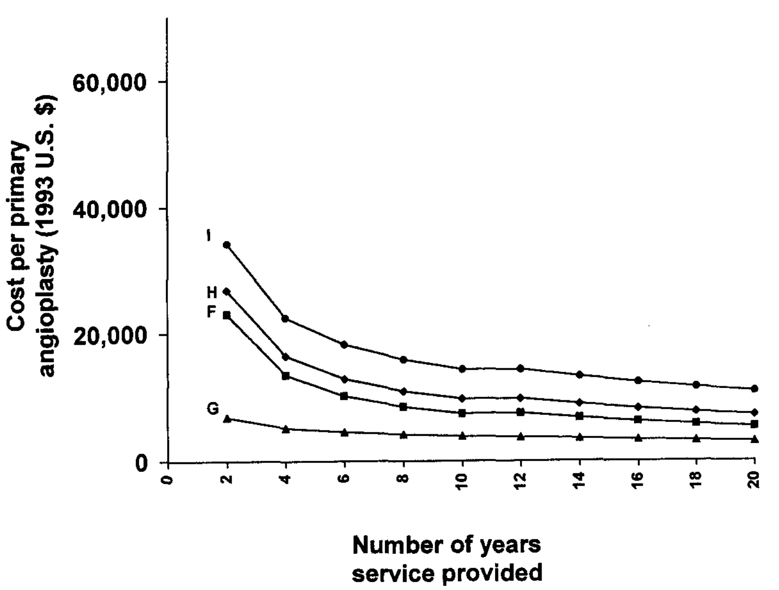


**Figure 2.** Sensitivity analysis showing the cost per primary angioplasty procedure as the number of years that the service is provided is varied. All scenarios in this figure assume that a new cardiac catheterization laboratory is built and equipped. See Table 1 for detailed descriptions of scenarios.

**Table 3.** Cost of Primary Angioplasty Under Varying Assumptions About Labor, Construction and Equipment Costs

| | Cost/Primary Angioplasty (U.S. $) | | | | |
|---|---|---|---|---|---|
| | Baseline | 50% of Baseline | 80% of Baseline | 120% of Baseline | 150% of Baseline |
| *Sensitivity to labor costs* | | | | | |
| Scenario D | 3,206 | 1,805 | 2,549 | 3,992 | 5,412 |
| Scenario E | 2,644 | 1,437 | 2,065 | 3,352 | 4,655 |
| Scenario F | 7,387 | 5,986 | 6,730 | 8,173 | 9,593 |
| Scenario G | 3,866 | 2,465 | 3,209 | 4,652 | 6,072 |
| Scenario H | 9,704 | 7,270 | 8,634 | 10,903 | 12,943 |
| Scenario I | 14,339 | 9,838 | 12,442 | 16,364 | 19,644 |
| Sensitivity to construction and equipment costs | | | | | |
| Scenario F | 7,387 | 5,297 | 6,551 | 8,223 | 9,478 |
| Scenario G | 3,866 | 3,536 | 3,734 | 3,998 | 4,196 |
| Scenario H | 9,704 | 7,488 | 8,818 | 10,591 | 11,920 |
| Scenario I | 14,339 | 11,872 | 13,352 | 15,325 | 16,806 |

See Table 1 for detailed descriptions of scenarios.

## Discussion

**Major findings.** Over the past decade, U.S. health care has increasingly been financed by capitated and prospectively paid systems. In this context, it is crucial for cardiologists to understand the actual costs of clinical services under various management scenarios (11). In many countries, the future of primary angioplasty as an intervention for acute myocardial infarction depends not only on clinical data but also on cost data (6,21,22). The current study questions the conventional wisdom that the initial cost of a primary angioplasty procedure is higher than that of a dose of a thrombolytic agent. In a nonprofit, high-volume setting with an existing cardiac catheterization laboratory, the $1,597 initial cost of a primary angioplasty procedure is lower than that of a dose of tissue plasminogen activator.

These results show that the cost of offering primary angioplasty will vary widely depending on the volume of procedures, existing resources at a given hospital and the method of providing cardiovascular surgical backup. The cost per primary angioplasty increases exponentially as the number of myocardial infarctions treated at the hospital decreases to <100 annually, or the number of years the procedure is used decreases to <6. In addition, if night call for technical personnel is a new expense or a cardiac catheterization laboratory needs to be built, the cost per primary angioplasty is double the most optimistic estimate, at ≥$3,206/procedure.

**Policy implications.** Decisions about whether to offer primary angioplasty should begin with the evidence on its clinical effectiveness. If recent findings (3–5,23) that the results of primary angioplasty are superior or equal to those of thrombolysis can be generalized, then the procedure's cost and cost-effectiveness will play a key role in whether and how it is implemented (6,24). Empiric cost and cost-effectiveness studies provide crucial information (8,25,26). However, generalizable models also are important for policymaking, because they show whether primary angioplasty will be cost-effective if it is offered under conditions that differ from those in empiric studies. The current model provides a foundation for further study of the projected cost-effectiveness of primary angioplasty under various population-based strategies for offering it.

The results of this study do not provide complete data because they focus only on the initial cost of primary angioplasty, which may be offset by a shorter hospital stay and lower rates of future angioplasty and CABG than those associated with thrombolysis (3,27,28). To better inform clinical policy decisions, a cost-effectiveness model that combines these initial cost data with other assumptions is needed. Such a cost-effectiveness model must take into account many other differences between primary angioplasty and thrombolysis, including short-term and long-term survival; rate of stroke; quality of life among survivors; length of hospital stay; rate of subsequent elective procedures; and specific patient groups that can benefit from the intervention, including those with cardiogenic shock or bleeding risk factors.

Some countries have considered or adopted regional triaging of urban patients with symptoms of myocardial infarction to high volume specialty centers that provide primary angioplasty as the preferred mode of therapy. In contrast, most U.S. patients with myocardial infarction present to hospitals without a cardiac catheterization laboratory. However, it has been suggested (29–31) that angioplasty services should be regionalized because clinical outcomes tend to be better at higher volume hospitals (29–31). This study's results add economic weight to this argument. The current findings confirm the belief (24) that building new laboratories to provide primary angioplasty at low volume hospitals would have extremely high economic costs, particularly in urban areas that already have excess existing capacity for elective procedures.

It has been suggested that performing angioplasty without on-site cardiovascular surgical backup may sometimes be acceptable, although this practice remains controversial (32,33). These results show that starting new cardiovascular surgical programs mainly to back up primary angioplasty would more than double the cost of offering primary angioplasty. In addition, adding night and weekend hours of service to a cardiac catheterization laboratory that is already offering daytime primary angioplasty has a relatively high incremental cost because the volume of procedures is relatively low and on-call costs are being paid every day.

**Comparisons and study limitations.** The $1,597 cost of primary angioplasty in this study's most optimistic scenario is far lower than the $7,556 found by using a university-based hospital's accounting system or the $6,635 Medicare diagnosis-related-group reimbursement rate for North Carolina (34). One reason is that the current study's baseline cost assumptions focus on the cost of adding primary angioplasty to an already operating laboratory. Thus, unlike the assessment of a typical hospital accounting system, our most optimistic scenario does not add a cost for facility and equipment depreciation because these costs have already been invested whether or not primary angioplasty is added to the services provided by the hospital. In addition, the costs presented here are based on those of a regional nonprofit health maintenance organization. This setting was chosen as the source of baseline assumptions because costs in a large nonprofit group practice are less likely to be distorted by cost shifting or contracting discounts than are indemnity-based charges to third-party payers or price-based costs from stand-alone hospitals. Thus, the costs reported here should be closer to the true economic costs experienced by large groups of providers and patients. In sensitivity analyses, cost inputs to this model were varied over wide ranges; these variations resulted in changes in the absolute cost of primary angioplasty but not in the model's general findings.

Our baseline scenario with an existing cardiac catheterization laboratory assumed that it operated at full capacity for elective procedures and, thus, labor costs were variable. However, many U.S. cardiac catheterization laboratories do not operate at peak volume (29,30). A cardiac catheterization laboratory that was underutilized might treat the cost of cardiologist and technical personnel salaries as fixed. Although its accounting system would probably report higher costs than those in this study, scenario E in this analysis shows that the true cost of adding primary angioplasty services in this situation would actually be lower than if labor costs were variable. Finally, because the costs in this model are discounted in future years and averaged over a period of years, the average costs expressed are less than the nominal expenditures on primary angioplasty in any given year.

**Conclusions.** We conclude that the initial cost of a primary angioplasty procedure under ideal circumstances is reasonable compared with that of the more expensive thrombolytic agent in widespread use. However, primary angioplasty would cost 3 to 10 times as much at hospitals without full existing resources, and would cost even more at hospitals that treated <200 patients with myocardial infarction annually. Policy decisions on primary angioplasty will need to weigh not only the initial costs presented here, but also the relative health benefits and long-term costs of thrombolysis and primary angioplasty. Further studies that compare the long-term effectiveness and cost-effectiveness of these interventions from a population-based perspective are needed.

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